

REMARKS

Please reconsider the application in view of the above amendments and the following remarks. Applicant thanks the Examiner for carefully considering this application.

Disposition of Claims

Claims 1, 4-5 and 7-8 are pending in this application. Claim 1 is independent. The remaining claims depend directly from claim 1.

Rejection(s) under 35 U.S.C. § 103Claims 1, 4, 7, and 8

Claims 1, 4, 7, and 8 are rejected under 35 U.S.C. § 103(a) as being obvious over JP 09330947 (“JP ‘947”) in view of JP 62004769 (“JP ‘769”) and JP 56018643 (“JP ‘643”). This rejection is respectfully traversed.

Epoxy resins may be cured with two different types of reagents. The first type curing agents are catalysts, which include cations and Lewis acids. The second type curing agents are nucleophiles that add to the epoxy rings. (paragraph [0004]¹). The catalyst-type curing agents typically require high temperatures (e.g., > 180 °C) for curing. (paragraph [0005]). The present invention provides adhesion materials using *in situ* generated cations that can cure epoxy resins at lower temperatures (e.g., 120 °C, see paragraph [0072]) and produce stronger adhesion (Table 1).

Independent claim 1 of the present application recites a method for producing an electrical device made up by a first object for bonding including a first electrode and a second object for bonding including a second electrode to be connected to said first electrode, by

bonding said first object for bonding and said second object for bonding to each other, comprising the steps of:

- arranging an adhesive, mainly containing a thermosetting resin and a silane coupling agent as a first curing agent, at least on said first electrode, to form an adhesive layer, wherein electrically conductive particles are added to said adhesive from the outset;
- arranging a second curing agent, reacted with said first curing agent by heating to polymerize said thermosetting resin, at least on said second electrode, to form a layer of the second curing agent, said second curing agent being mainly composed of one or both of an aluminum chelate and an aluminum alcoholate;
- positioning said first and second electrodes in register with each other;
- tightly contacting said adhesive on said first object for bonding with said second curing agent on said second object for bonding; and
- thrusting and heating said first and second objects against each other for bonding to develop a cation by reaction of said silane coupling agent as a main component of said first curing agent and one or both of said aluminum chelate and said aluminum alcoholate of the second curing agent and for interconnecting said first and second electrodes through said electrically conductive particles and allowing said thermosetting resin to be cationically polymerized by heating.

Thus, according to claim 1, the first curing agent mainly composed of the silane coupling agent and the second curing agent mainly composed of one or both of the aluminum

¹ The paragraph numberings are based on the published application 2005/0257886.

chelate and aluminum alcoholate are arranged on separate objects for subsequent bonding. Therefore, the silane coupling agent and one or both of the aluminum chelate and aluminum alcoholate do not react and generate cations until the first and second objects are thrust together and heated. Because of this separation, cationic polymerization of the thermosetting resin does not occur until the objects are brought together, thereby maintaining long shelf life and high adhesion intensity.

JP '947 discloses a method of producing an electrical device comprising arranging an adhesive layer containing a curable resin and electrically conductive particles (added to the adhesive at the outset) on a first electrode of a first object, arranging an adhesive layer on a second electrode of a second object, positioning the first and second electrodes in register with each other, and with the first and second object facing each other, tightly connecting the adhesive layer on the first object to the adhesive layer on the second object, thrusting the first and second objects against each other to interconnect the first and second electrodes via the electrically conductive particles, and allowing the curable resin to be polymerized by heating.

The method taught in JP '947 (use of adhesive layers on each of the two objects to be joined) allows for adhesive method to be used in bonding a semiconductor device and a substrate, even with changes in the electrode height (without short circuiting). *See* [0003], [0005]-[0006], and [0018]. Other than the use of electrically conductive particles and a curable resin, there is no discussion or suggestion in JP '947 of the types of components used on the first and second layers, much less whether the adhesive components in the first and second adhesive layers are the same or different. According to the description in paragraph [0005] of JP '947, JP '947 the intent of its method to simplify the manufacturing process and reduce costs, particularly

for bonding a semiconductor device and substrate where the electrode height may vary. Thus, not only is the actual process of JP '947 different from the present application, but also for a different purpose.

On the other hand, use of the claimed curing agents on the first and second objects provide an adhesive having a long shelf life, and which may be cured at a lower temperature and for a shorter time than generally achievable. The method for producing the electrical device taught in JP '947 was not intended to provide the same type of adhesive claimed in the present application, and the composition of the method of JP '947 differs from the claimed method.

The Examiner relies on JP '769 and JP '643 as teaching the claimed arrangement of curable adhesive. However, Applicant respectfully asserts that neither JP '769 nor JP '643 shows or suggests the claim limitations missing in JP '947.

JP '769 discloses bonding two planar conductor substrates together by applying a principal ingredient of a two-pack adhesive to one board, applying the hardener thereof to another board, and bonding them together when desired. When brought into contact, the applied layers are gradually cured by diffusion from the contact surfaces to form an adhesive layer. However, JP '769 merely bonding these two planar substrates together, not connecting first and second electrodes arranged on the first and second objects via electrically conductive particles. Further, also it is mentioned that there may be a preferred blending ratio between the principal ingredient (resin) and hardener (curing agent), there is no mention in JP '769 of the type of resin, curing agent, or type of curing reaction, which are each specified in claim 1 of the present application.

In JP '643, two-pack adhesive is generally taught. In this two-pack adhesive according to JP '643, a solution of first components containing an organosilicic compound in an epoxy resin and a solution of second components containing an aluminum compound in an epoxy resin are preserved separately. The first and second solutions are then mixed at the time of use to react the silanol and aluminum chelate, which polymerizes the epoxy resin. However, JP '643 only discloses a general cationic curing system, and has no suggestion of how to apply the two-pack adhesive to objects for bonding. Specifically, there is no suggestion of whether the two solutions are applied to one surface or two surfaces, when the surfaces are adhered together, whether the silanol and aluminum chelate are applied to two surfaces and not reacted to generate cations until the surfaces are adhered together, etc, specifics of which are all recited in claim 1.

The Examiner broadly asserts that it would have been obvious to use as the two adhesive layers arranged on the first and second electrodes as taught in JP '947, the two-pack adhesive of JP '643, as two layers on the first and second objects shown by JP '769 so that the adhesive is cured between the two objects when desired. However, Applicant respectfully asserts that the combination of these three references does not necessarily result in the claimed method as asserted by the Examiner. Rather, for example, JP '769 teaches that the hardener is separated from the curing agent. This would suggest that the complete curing agent, the first and second curing agents combined, would be present on one layer, and the curable resin would be separated on the other layer.

However, the inventors of the present invention have unexpectedly found that by generating (from silanes and aluminum chelates/alcoholates) the cations *in situ* when needed, it becomes possible to polymerize the resins at significantly lower temperatures and the products have markedly better adhesive strength (as assessed by the peel-off strength).

TABLE 1

<u>Results of Peel-Off Strength Test</u>						
	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Comp. Ex. 1	Comp. Ex. 2
Peel-off Strength (N/cm)	11.5	11.8	13.2	13.4	1.3	1.3

As shown in Table 1 (reproduced above), Example 1 through 4 are two-part formulations in accordance with embodiments of the invention. The catalysts (cations) are formed *in situ* when the two parts are brought into contact and heated. The Comparative Examples 1 and 2 have the same compositions as in Examples 1 and 2, but where the first and second curing agents were combined together. As shown in Table 1, the peel-off strengths (a measure of adhesive strength) of Examples 1 and 2 are about 9 folds or more higher than the corresponding Comparative Examples 1 and 2. According to the present application, it is possible to connect two objects for bonding at a lower temperature and with a shorter time than a conventional adhesive, and even given that, the peel strength is greater. By having such high peel strength, the present application realizes high adhesion intensity. From general technical common knowledge, it is clear that there is a correlating relationship between adhesion intensity and the reliability of the connection between the two objects bonded together. Accordingly, using the methods of the present application, connection reliability is high due to the high peel strength and adhesion intensity. Such dramatic improvements are unexpected and rebut the *prima facie* case of obviousness. (MPEP § 2145 states that rebuttal evidence may also include evidence that the claimed invention yields unexpectedly improved properties or properties not present in the prior art. *See also, In re Dillon*, 919 F.2d 688, 692-93 (Fed. Cir. 1990)).

As demonstrated in examples 1-4 of the present application, the cured adhesive possesses high peel strength due to the separation of the first and second curing agents on the

objects for bonding, whereas such high peel strength does not result in comparative examples 1 and 2, which combined the first and second curing agents in the adhesive layer, is low so as not to be able to bear practical use.

Further, according to the present application, by generating cations by reaction of the silane coupling agent (as the main component of the first curing agent) with one or both of the aluminum chelate and aluminum alcoholate (as the main component of the second curing agent), the thermosetting resin is cationically polymerized at a lower temperature and for a shorter time than with a conventional adhesive.

None of JP '947, JP '769, or JP '643 shows or suggests such features claimed in claim 1, nor the effects which advantageously result from such claimed features. Therefore, there is no teaching, suggestion, or motivation to modify these references to achieve the invention as claimed in the present invention.

Thus, because JP '947, JP '769, and JP '643, whether considered separately or in combination, fails to teach or suggest separation and subsequent reaction between a silane coupling agent and an aluminum chelate and/or alcoholate on two objects to generate cations and trigger polymerization of a resin upon thrusting and heating of the two objects, claim 1 is patentable in view of JP '947, JP '769, and JP '643. Dependent claims are patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Claim 5

Claim 5 is rejected under 35 U.S.C. § 103(a) as being obvious over JP '947, JP '643, and JP '769, as applied to claims 1, 4, 7, and 8 above, and further in view of JP 09067427 ("JP '427"). This rejection is respectfully traversed.

As described above, JP '947, JP '769, and JP '643 do not show or suggest separation and subsequent reaction between a silane coupling agent and an aluminum chelate and/or alcoholate on two objects to generate cations and trigger polymerization of a resin upon thrusting and heating of the two objects, as required by claim 1.

JP '427 merely mentions that a silane coupling agent modified phenol resin obtained by reacting a silane coupling agent with a phenol resin. However, it is not mentioned that the silane coupling agent reacts with one or both of aluminum chelate and aluminum alcoholate. Moreover, there is also no suggestion of separation and subsequent reaction of a silane coupling agent from an aluminum chelate and/or alcoholate on two objects to generate cations and trigger polymerization of a resin upon thrusting and heating of the two objections, as required by independent claim 1, from which claim 5 depends.

Thus, because JP '947, JP '769, JP '643, and JP '427, whether considered alone or in combination, fail to teach or suggest separation and subsequent reaction between a silane coupling agent and an aluminum chelate and/or alcoholate on two objects to generate cations and trigger polymerization of a resin upon thrusting and heating of the two objects, claim 1 is patentable in view of JP '947, JP '769, JP '643, JP 427. Dependent claim 5 is patentable for at least the same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Claims 1, 5, 7, and 8

Claims 1, 5, 7, and 8 are rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent Publication No. 2002/0151627 to Matsushima in view of JP 07082533 ("JP '533"). Claim 4 is rejected under 35 U.S.C. § 103(a) to Matsushima and JP '533, as applied to claim 1, and further in view of either U.S. Patent No. 4,772,672 to Isozaki or JP 07011152.

The Applicant respectfully notes that Matsushima is a § 102(e) reference and that both the present application and Matsushima were at the time the invention was made, owned by Sony Chemicals Corporation, now named Sony Chemical and Information Device Corporation. The assignment (and change of name) for the present application are recorded at Reel 016041, Frame 0799 and Reel 018550, Frame 0258, and the assignment (and change of name) for Matsushima are recorded at Reel 021794, Frame 0292. Thus, under 35 U.S.C. § 103(c), Matsushima cannot be used as the basis for a § 103 rejection. Therefore, all of the § 103 rejections that are based on Matsushima are untenable and must be withdrawn. Accordingly, withdrawal of this rejection is respectfully requested.

Conclusion

Applicant believes this reply is fully responsive to all outstanding issues and places this application in condition for allowance. If this belief is incorrect, or other issues arise, the Examiner is encouraged to contact the undersigned or his associates at the telephone number listed below. Please apply any charges not covered, or any credits, to Deposit Account 50-0591 (Reference Number 17155/003001).

Dated: April 16, 2009

Respectfully submitted,

By T. Chyau Liang, Ph.D. Thomas Schleske
T. Chyau Liang, Ph.D. Registration No.: 48,885
OSHA · LIANG LLP
909 Fannin Street, Suite 3500
Houston, Texas 77010
(713) 228-8600
(713) 228-8778 (Fax)
Attorney for Applicant